NOTES

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MAPPING AND SURVEYING PRACTICES ADAPTED TO USE IN LESS DEVELOPED AREAS.

BY

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Introduction:

1. Science and Technology are making spectacular and tremendous advances and the already developed countries which are right in the thick of these advances, are being supplied with this catalyst to further their development. The less developed countries must hasten, not only to make up for lost ground, but also to catch up with modern developments. They are yearning for development. They must neither be static nor be in dynamic equilibrum. They must marshall all their forces and harness all their resources in order to accelerate the rate of development.

2. The land is the primary asset of man and all economic growth is traced to it. The mineral resources beneath the earth's surface must be explored, the energy entrapped in waterfalls must be converted to power, the navigability of rivers must be investigated. Towns and country side must be planned. It is therefore of fundamental importance that a system of evaluating this primary asset of man must be evolved. Human resources are also vital. It is here that surveys and maps come in. A survey map can depict, on a plane sheet of paper, the general features of the earth's surface in all its dimensions and show the distribution of man power.

3. The less developed countries are handicapped not only because they are late starters in the race for development but also because they are relatively poor. If the less developed countries are to accelerate, or even maintain their rate of development, they must adopt a method of mapping which is fast, accurate and economical.

4. Great treks of surveyors used to be familiar sights negotiating jungles, marshes and deserts, making the maps as they went along. This method is necessarily slow and laborious. It is not surprising that maps, produced under such conditions, were not free from errors. One of such maps is the Burmi Sheet of Northern Nigeria in which some towns were found to be as much as 8 miles out of position.

5. Photogrammetry has revolutionised surveying; maps can now be produced from aerial photographs with the aid of plotting machines and equipment. The process is less laborious and consumes less man power. It does not however follow that some of the devices, like aero-triangulation, will cut down cost in the mapping of easily accessible areas particularly in less developed areas where labour is relatively cheap. But when this is considered along-side with the plotting of details there can be no doubt that photogrammetry is the obvious answer to the mapping of under developed countries; it may however have to be adopted without some of its trimmings.

Aerial Photography.

6. The first essential in photogrammetry is the production of aerial photographs at suitable scales for both planimetry and altimetry. The aircraft must therefore be equipped with instruments which will satisfy this requirement. Cameras with wide angle lens of about 90° and 6" focal length are usually used for taking photographs. Some of the less developed countries around the equator have low clouds for most part of the year, and consequently the period during which photographs could be taken is restricted. A new device of using cameras with super wide angle lens of about 120° and shorter focal length of about 3½" enables the aircraft to fly at a lower altitude to obtain photographs at the same scales. Another device is the use of Infra Red Film for photography. This permits some penetration through haze, thus increasing the number of days on which photographs can be taken. Also the drainage detail and vegetation are more rigorously defined than with Panchromatic Film. These two devices combined were reported to have produced spectacular results in Nigeria. It has been possible to obtain photographs at a scale of 1/40,000 at the first attempt. Previous attempts to obtain photographs at the same scale with a

camera with 6" lens using panchromatic film were unsuccessful. It has been suggested that this success has been due to a spot of good weather but the effect of the new devices cannot be ruled out.

7. Another modern device which was designed by the National Research Council, Canada is the Airborne Profile Recorder (A.P.R.) which gives the height of the aircraft above the ground as it flies along. It has not been widely used but it is considered by some of those who have used the method that it is too expensive and that if its application is not conducted concurrently with aerial photographs, there is a danger of losing time. It has been found to have unquestionable advantages in desert areas and has also been used successfully over mountains in Arizona. The National Research Council of Canada have used the A.P.R. for "determining scale (and hence horizontal distances) on aerial photographs. They have also developed methods for using it for bridging between widely separated ground control points a requirement required when mapping a new area containing only limited known points of control".[2] This instrument may still have a future in less developed areas.

8. Most of the less developed countries lack the financial resources and the technical know-how to own, equip and operate an aircraft for photography alone. They therefore depend on the services of firms operating from the more developed countries. Some of these less developed countries are developing Air Forces of their own for defence purposes; and as these become more established it may be more economical for them to adapt some aircraft for aerial photography. These aircraft will be available for other purposes during the off-season, as is the case with the Department of Highways of the state of Minnesota in U.S.A. which operates its own aircraft for aerial photography and during the off-season uses it for assisting the highway patrol in obtaining information about traffic congestion.

9. The pattern of life in the less developed countries is changing at such a rapid rate that within a short time maps become out-of-date. There are instances where a whole village has migrated to a new site usually along a main road. Also, new roads are being constructed to open up the hinterland. It will therefore be necessary to retake aerial photographs at regular intervals for periodic revision of maps. Developing Countries must therefore regard aerial photography as a long-term project.

Ground Control.

10. Before maps can be produced from aerial photographs, there must be some means of linking the photographs with the details on the ground. Some points on the photographs are identified on the ground and the positions of these points rigorously determined. It is to these 'ground control points' that the map is hinged.

11. The Symposium Organised by the Inter-African Committee for Surveys and Maps of the C.C.T.A. at Salisbury Southern Rhodesia in June, 1962 showed that opinion is divided on the method of obtaining ground control points. One school of thought, which is predominantly British in origin, holds the view that ground control points should be based on geodetic control either by triangulation, trilateration or traversing. This system, they hold, may be more expensive, but in a rapidly developing community, these points would serve as the basis for other maps required for development projects. They however realise that in sparsely populated areas or in places which are difficult to penetrate, geodetic control may not justify the expense at present. The other school of thought, which draws its inspiration from France, is convinced that under the present condition in less developed countries, control should be supplied by astronomical observations. This will facilitate a more rapid and more economical mapping of the area. It is claimed that sufficient accuracy has been achieved through this method which has been a specific advantage in mapping sparsely populated or desert area.[3]

12. It is significant to note that while the first school of thought considers a scale of about 1/50,000 as the most suitable for topographical mapping the second adopts a scale of 1/200,000. It is obvious therefore that the larger scale map must be based on a more rigid control. Also some of the former French territories in Africa which border on the Sahara desert may at present make do with maps on smaller scales. The Sahara Desert is, however, growing in importance with the discovery of mineral deposits and it may not be long before the maps of this area may have to be based on a more accurate and rigid control. Areas which are of no economic importance today may be vital tomorrow, requiring accurate maps. If we consider this and the needs of densely populated areas we may come to the

conclusion that the time may not be far distant when the necessity of geodetic control will be universally accepted.

13. Electronic methods of measuring distances, for example, the Tellurometer and Geodimeter are now being used in establishing ground control. This new discovery produces a great saving in time, and makes it possible for observations to be taken under otherwise unfavourable conditions. The harmattan used to be a great handicap for geodetic observations but it has been possible in Nigeria to measure a distance of about 28 miles, in both directions in under 30 minutes in harmattan and yet get agreement of about 1/170,000. In U.S.A. and Canada geodetic bases are now measured with the Geodimeter. Although electronic methods are fast and consume less man-power they are rather difficult to use in flat or heavily forested areas because the stations may not be intervisible. In these areas, high towers may be the solution but tall tropical trees may make the cost of installing towers which are high enough to afford intervisibility rather exorbitant. There is also the heavy expense of transport for the equipment and towers. Another disadvantage with the Geodimeter is that work has to be done at night when it is dark and the visibility is good. The heavy expense in flat or forested countries may limit the use of electronic instruments but they are invaluable in hilly countries. However, accuracies ranging between 1/10,000 and 1/100000 had been obtained from tellurometer traverses in Nigeria along the River Niger with legs varying from 3 to 15 miles. The total distance of 370 miles was measured in about 3 months with a party of 12 men, 3 of whom were survey personnel. In contrast it took another survey party of 20 men including 2 survey personnel about the same time to run a traverse of about 35 miles along a main road.

14. As it has been stated above, in settled areas it may be more economical to supply ground control by ground methods but in inaccessible areas and in difficult terrain where it is not easy to establish survey beacons, the answer lies in the possession of photogrammetric machines for supplying additional ground control points by aero-triangulation.

Technique of Mapping.

15. Maps are expensive to produce. But up-to-date and accurate topographical maps are invaluable for any scientific planning and for economic development. The high initial cost of equipment and establishing control points drives some people to the conclusion that the less developed countries, yearning for development, cannot afford the luxury of up-to-date, accurate topographical maps, and their immediate needs should be met by rapid planimetric maps, on the ground that a bad map is better than no map at all. This may be correct for administrative maps showing political and administrative boundaries and for social maps showing distribution of amenities. But it may eventually prove to be false economy because scientific users of maps would soon be demanding accurate contoured maps depicting the topography. The Director of Geological Surveys, Nyasaland confirmed this view when he wrote, 'Contours are of the greatest value, and there is no comparison in usefulness between the old "Preliminary Plot" series originally issued by the Directorate of Overseas Surveys and later contoured sheets of the same areas. A vertical interval of 50 feet is suitable for most purposes of regional geological survey. Contours are much preferable to hill shading in that they display structural trends more satisfactorily, are more useful in fixing position and, furthermore, permit calculation of structures of exposed strata.'

16. The technique of mapping in less developed areas should be such as would make possible the production of accurate topographical maps. The developing countries are limited by their relatively meagre resources and by pressure from all directions for financial consideration. It is easy to see the necessity for hospitals, it is the common desire of every citizen for education; the fact that survey is the basis of all these social amenities is obscured. It is therefore not surprising that on the average of 1% of the Budget of developing countries is spent on Survey while Health and Education take about a third each. But if the race for development must be speeded up then developing countries must invest more on surveying by acquiring expensive, precision stereo-plotting machines. These will aid the production of useful maps which will yield dividends in overall development.

Requirement of National Cartographic Unit.

17. A National Cartographic Unit must therefore find room for such modern equipment not only for planning and executing surveys and printing and publishing accurate topographical maps but also to be able to conduct research into all aspects of mapping. In some of the

more developed countries separate research institutions exist like the National Research Council of Canada, but the less developed countries lack the human and financial resources for establishing similar institutions. The task of conducting research will consequently devolve on the National Cartographic Unit. Such an establishment must be directed by personnel who are capable of undertaking research and also keeping in touch with Research Establishments elsewhere and adapting the knowledge so gained to local conditions. It was as the result of such research that it was possible as stated in paragraph 7, to obtain photographs in Nigeria of an area which has beaten photographers for several years. The Federation of Rhodesia and Nyasaland is also attempting to produce maps on a scale of 1/50,000 from 1/80,000 photographs.

18. Training must receive the attention of such a Unit in order to maintain a steady flow of skilled personnel. Cartographers are usually trained on the job since there is no educational institution running formal courses for them. In some parts of Africa a considerable measure of success has been achieved in building training in cartography on primary education. There must also be facilities for training surveyors and photogrammetrists so that there may be no more necessity for sending professional officers to the more developed countries for general training. We have found that in Nigeria it is possible to give our students far more field work than I have observed is customary in England or America because the climatic conditions of the tropics favour all-the-year-round field work. It may not be idle dream to hope that the less developed countries may in due course offer the best training ground for field surveyors the world over.

Co-operation Between Less developed and developed countries.

19. The Inter-African Committee for Surveys and Maps at its 4th. Meeting in Salisbury, Southern Rhodesia considered "that whilst the training of technicians could normally be undertaken within Africa, Member Governments would have to continue to rely, for the training of technologists and professional surveyors on existing facilities, which were largely outside Africa"[5]. This should be an interim measure and as stated in the preceding paragraph the less developed countries should aim at giving general training at all levels locally. The training will then be related to the background of the candidates and will thus be of better service to the community.

20. In other professions like Medicine, Engineering and Law the emphasis now is for general training to be given locally to accommodate training to local conditions; Surveying should not be an exception. But the less developed countries will have to rely on the assistance of other countries for the training of specialists, who will build their specialised training on their local background and return home to organise the rapid mapping of their countries. It may be said that the less developed countries are receiving external aid for mapping, with the personnel and field equipment supplied by the donor countries. This type of aid satisfies immediate need in that the urgently needed maps are produced. But, as it has been stated in paragraph 9, the general pattern of life in the less developed areas is constantly changing and, within a short time the maps will be out of date, requiring revision. The recipient country should later be able to carry out the revision and complete the mapping themselves. Thus, it is obvious that if maximum benefit is to be derived from external assistance, it should be in the supply of equipment, and skilled personnel to give instruction and direction to the local officers so that they may acquire the knowledge, skill and experience to do the work unaided.

21. Vast areas of the less developed countries are still unmapped and the task ahead is gigantic. These areas are ideal testing grounds for modern instruments and machines. Not only must advantage be taken of knowledge and experience gained elsewhere but also new methods must be devised and old ones improved from experience gained in the less developed areas, enriching our store of knowledge and perfecting our technique. The interchange of ideas could be of lasting value demostrating the vital importance of International co-operation.

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